

## Purpose:

Conduct basic and applied research focused on identifying and developing sustainable, renewable energy sources.

## Participating Departments:

- Energy Sciences & Technology
- Biology
- Condensed Matter Physics and Materials Science
- Chemistry
- National Synchrotron Light Source
- Center for Functional Nanomaterials

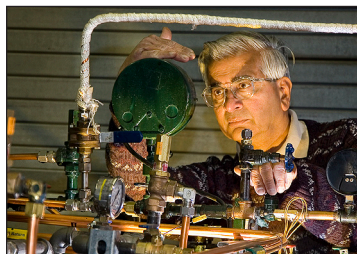
## Contacts:

Doon Gibbs  
Associate Lab Director for  
Basic Energy Sciences  
631-344-4608  
gibbs@bnl.gov

Fritz Henn  
Associate Lab Director for  
Life Sciences  
631-344-4049  
fhenn@bnl.gov

Ralph James  
Associate Lab Director for Energy,  
Environment, & National Security  
631-344-8633  
rjames@bnl.gov

William Horak  
Chair, Energy Sciences &  
Technology Department  
631-344-2627  
horak@bnl.gov



Brookhaven scientists design ultrahigh-efficiency boilers that burn 100% biofuels

# Energy Sciences at Brookhaven

U.S. reliance on imported fossil fuels has a significant impact on the nation's economy. It is also counter to our goal of energy independence, which is crucial for our nation's future success and security and will likely be the most important problem of the 21st century.



Researchers modify plant enzymes to produce saturated oils that can replace petrochemicals

Developing sustainable, renewable fuels is key to solving that problem. Brookhaven National Laboratory's basic and applied research programs seek breakthroughs and high-impact advances in the effective use of renewable energy through improved conversion, transmission, and storage. The Lab is developing new, integrated programs that cover the spectrum from basic discoveries, to applied research, to technology deployment.

BNL's growing energy portfolio features research in biofuels, solar energy, energy efficiency, energy storage, and nuclear energy. Research goals and highlights are detailed below.

## Biofuels

BNL's biofuels research focuses on discovering novel processes for the production of biofuels from a variety of sources, and testing the viability of various biofuel formulations in different applications. Our end goal is to increase acceptance and use of biofuels in the U.S. by optimizing biofuel formulations and reducing production costs. Some of the more promising research includes:

- Working with microbes to promote faster plant growth
- Using algae to produce biodiesel from atmospheric carbon dioxide
- Genetically designing poplar trees so their cellulose can more

easily be converted to biofuel

- Using microbes and thermochemical processes to produce fuel from cellulose
- Characterizing the properties and performance of biofuels through fuel research and demonstration programs.

Also, through the Department of Energy's Genomes to Life program, BNL researchers look to make transformational breakthroughs in sustainable, cost-effective alternative-fuels production. The Lab's goal is to advance production technologies based on genomic and molecular analysis of plant and microbial systems. This research is open-ended and flexible, so BNL can adjust and deliver various products needed by the market as it develops.

## Solar Energy

BNL's solar energy research focuses on optimizing materials used in solar cells, thereby minimizing environmental impacts associated with their production; optimizing solar energy systems to improve the economics of solar energy and spread its use; and producing efficient, cost-effective photovoltaic devices and solid-state lighting. This research includes:

- Studies on integrating solar generation and storage technologies

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## Energy Sciences at Brookhaven (continued)

- Economic modeling of alternative energy solutions to determine market impacts
- Nanoscience research on electron charge separation and capture, key to advanced photovoltaic devices
- Basic research to develop a viable industrial solar-to-fuels process, such as splitting water to make hydrogen.

### Energy Efficiency/Storage

BNL's energy efficiency research focuses on reducing electricity consumption, leading to lower electricity bills, decreased reliance on fossil fuels for electricity production, and a reduction in greenhouse gases. By developing effective technologies for energy storage, BNL researchers will enable renewable energy to flourish by compensating for the intermittency of the sun. Research highlights include:

- Basic electrochemical research to significantly improve the efficiency and reliability of fuel cells and batteries
- Study of emerging technologies, such as ground-source heat pumps and biofuel-driven heating appliances, to improve energy efficiency in buildings

- Basic nanocatalysis research to develop materials that speed chemical reactions, key to efficient and clean hydrogen production for fuel cells
- Developing high-temperature superconductors, which would enable efficient energy transmission and storage and transform the electric grid.

### Nuclear Energy

BNL's nuclear energy research focuses on improving the economics of nuclear power and reducing concerns associated with reactor safety and waste, with the goal of enabling increased acceptance and use of nuclear power as a means of reducing U.S. dependence on imported fossil fuels. Research in this area includes:

- Studying advanced nuclear fuels and separations
- Using models to determine new means to reduce waste and produce energy by recycling nuclear fuel
- Providing guidance on reactor safety and licensing issues
- Enabling new safeguards approaches to reduce the risk of nuclear proliferation.



BNL's newest user facility, the Center for Functional Nanomaterials (CFN). The CFN's overarching scientific theme is the development and understanding of nanoscale materials that address the nation's challenges in energy security.

